14 INDUSTRIAL MAINTENANCE MECHANICS

PREVENTIVE AND PROSPECTIVE INDUSTRIAL MAINTENANCE MECHANICS

PROGRAM OF STUDY

BZW-511
5512

PRELIMINARY VERSION

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VOCATIONAL EDUCATION *in Secondary School*

Québec

PREVENTIVE AND PROSPECTIVE INDUSTRIAL MAINTENANCE MECHANICS

PROGRAM OF STUDY
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INDUSTRIAL MAINTENCANCE MECHANICS

PREVENTIVE AND PROSPECTIVE INDUSTRIAL MAINTENANCE MECHANICS

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BZW-511
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The *Preventive and Prospective Industrial Maintenance Mechanics* program leads to the Attestation of Vocational Specialization (AVS) and prepares the student to practise the trade of

PREVENTIVE AND PROSPECTIVE INDUSTRIAL MAINTENANCE MECHANIC

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Although much research went into the choice of technical terminology in the English version, some terms may not reflect current usage or may be inaccurate. The Education Development in the English Language team would much appreciate receiving feedback from users of this document. The translators may be contacted at:

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INTRODUCTION

The *Preventive and Prospective Industrial Maintenance Mechanics* program is based on the orientations for secondary school vocational education adopted by the government in 1986. It was designed on the basis of a new framework for developing vocational education programs that calls for the participation of experts from the workplace and the field of education.

The program of study is developed in terms of competencies, expressed as objectives. These objectives are divided into modules, which are organized into teaching blocks. Various factors were kept in mind in developing the program: training needs, the job situation, purposes, goals, and strategies and means used to attain objectives.

The program of study lists the competencies that are the minimum requirements for an **attestation of vocational specialization (AVS)**, for students in both the youth and adult sectors. It also provides the basis for organizing courses, planning teaching strategies, and designing instructional and evaluation materials.

The duration of the program is 450 hours, which includes 210 hours spent on the specific competencies required to practise the trade or occupation and 240 hours on general competencies. The program of study is divided into 8 modules which vary in length from 15 to 90 hours (multiples of 15). The time allocated to the program is to be used not only for teaching but also for evaluation and remedial work. The modules are arranged in one block of 450 hours.

This document contains two parts. Part I is of general interest and provides an overview of the training plan. It includes a synoptic table of basic information about the modules, a description of the program training goals, the competencies to be developed and the general objectives, and an explanation of operational objectives. Part II is designed primarily for those directly involved in implementing the program. It contains a description of the operational objectives of each module.

In keeping with this broad approach, three accompanying documents will be provided: a teaching guide, an evaluation guide, and a planning guide.

GLOSSARY

Program Training Goals

Statements that describe the educational aims of a program. These goals are the general goals of vocational education adapted to a specific trade or occupation.

Operational Objectives

Statements of the educational aims of a program in practical terms. They serve as the basis for teaching, learning, and evaluation.

Competency

A set of socio-affective behaviours, cognitive skills or psycho-sensori-motor skills that enable a person to correctly perform a role, function, activity or task.

Module of a Program

A component part of a program of study comprising a first-level operational objective and the related second-level operational objectives.

General Objectives

Instructional objectives that provide an orientation for leading the students to attain one or more related objectives.

Credit

A unit used for expressing quantitatively the value of the modules in a program of study. One credit corresponds to 15 hours of training. Students must accumulate a set number of credits to graduate from a program.

PART I

1. SYNOPTIC TABLE

Number of modules: 8
Duration in hours: 450
Credits: 30

Preventive and Prospective Maintenance Mechanics
SIMCA: 000-000
SESAME: 0000

SIMCA	SESAME	TITLE OF THE MODULE	HOURS	CREDITS*
BED-288	867-011	1. The Trade and the Training Process	15	1
BED-289	867-022	2. Interpreting Complex Plans, Specifications, and Manuals	30	2
BEE-281	867-034	3. Applying Techniques for Measuring Vibrations	60	4
BEE-282	867-043	4. Applying Concepts of Preventive and Prospective Industrial Maintenance	45	3
BEE-283	867-055	5. Using Computer Programs for Planned Maintenance	75	5
BEE-284	867-065	6. Diagnosing Malfunctions by Means of Vibration Analysis	75	5
BEE-285	867-076	7. Designing and Setting up a Planned Maintenance System	90	6
BEE-286	867-084	8. Entering the Job Market	60	4

* 15 hours = 1 credit
This program leads to an AVS in Preventive and Prospective Industrial Maintenance Mechanics.

Direction des Communications
Ministère de l'Éducation

2. PROGRAM TRAINING GOALS

The training goals of the *Preventive and Prospective Industrial Maintenance Mechanics* program are based on the general goals of vocational education and take into account the specific nature of the trade or occupation. These goals are:

To develop effectiveness in the practice of a trade or an occupation.

- To teach students to perform preventive and prospective industrial maintenance mechanics tasks and activities correctly, at an acceptable level of competence for entry into the job market.

- To prepare students to perform satisfactorily on the job by fostering:

  - the intellectual skills needed to use vibration analysis and computer programs for preventive and prospective maintenance tasks
  - the intellectual skills needed to efficiently diagnose and analyse malfunctions in industrial equipment in a preventive and prospective maintenance context
  - the ability to establish harmonious relationships and to communicate effectively in the workplace
  - the development of their sense of professional ethics
  - a constant concern for health and safety and the development of an attitude of vigilance
  - precision in the performance of tasks
  - the ability to work in emergency situations and under limiting conditions

To ensure integration into the working world.

- To familiarize students with the trade of preventive and prospective industrial maintenance mechanics in particular.

- To familiarize students with the rights and responsibilities of workers.

- To encourage students to respect the customers' rights and expectations.

To foster the development of occupational knowledge.

- To foster independence and instill a sense of responsibility and a desire to succeed.

- To help students develop their ability to learn, gather information, and acquire effective work methods.

- To help students understand the underlying principles of the techniques used.

- To help students develop the basic attitudes necessary for a successful professional life, such as a sense of responsibility and a concern for excellence.

To ensure job mobility.

- To help students develop a positive attitude toward technological change and new situations.

- To help students develop their creativity and initiative.

- To prepare students for a creative job search.

3. COMPETENCIES

The competencies to be developed in the *Preventive and Prospective Industrial Maintenance Mechanics* program are shown in the grid of learning focuses on the following page. The grid lists general and specific competencies as well as the major steps in the work process.

General competencies involve activities common to several tasks or situations. They cover, for example, the technological or scientific principles that the students must understand to practise the trade or occupation. Specific competencies focus on tasks and activities that are of direct use in the trade or occupation. The work process includes the most important steps in carrying out the tasks and activities of the trade or occupation.

The grid of learning focuses shows the relationship between the general competencies on the horizontal axis and the specific competencies on the vertical axis. The symbol (△) indicates a correlation between a specific competency and a step in the work process. The symbol (◯) indicates a correlation between a general and a specific competency.

The symbols (▲) and (●) indicate that these relationships have been taken into account in the formulation of objectives intended to develop specific competencies related to the trade or occupation.

The logic used in constructing the grid influences the course sequence. Generally speaking, this sequence follows a logical progression in terms of the complexity of the learning involved and the development of the students' autonomy. The vertical axis of the grid shows the competencies directly related to the practice of a specific trade or occupation. These competencies are arranged in a relatively fixed order; therefore, the modules should be taught, insofar as possible, in the order represented on the grid. The modules including the general competencies on the horizontal axis should be taught in relation to those on the vertical axis. This means that some modules are prerequisite to others, while other modules are taught concurrently.

GRID OF LEARNING FOCUSES

PREVENTIVE AND PROSPECTIVE INDUSTRIAL MAINTENANCE MECHANICS

	SPECIFIC COMPETENCIES (directly related to the practice of the specific occupation)	FIRST-LEVEL OPERATIONAL OBJECTIVES	DURATION (IN HOURS)	WORK PROCESS (major steps)							GENERAL COMPETENCIES (technology, personal development, etc.)									TOTALS	
				Use a maintenance sheet	Plan their work	Take safety measures	Do the work	Clean and tidy up	Write reports	Interpret complex plans, specifications and manuals		Apply techniques for measuring vibrations		Apply concepts of preventive and prospective maintenance		Use computer programs for planned maintenance				NUMBER OF OBJECTIVES	DURATION (IN HOURS)
	MODULES										2		3		4		5				
	FIRST-LEVEL OPERATIONAL OBJECTIVES										B		B		B		B			4	
	DURATION (IN HOURS)										30		60		45		75				210
1	Determine their suitability for the trade and the training process	S	15								○		○		○		○				
6	Diagnose malfunctions by means of vibration analysis	B	75	▲	▲	▲	▲	▲	▲		●		●		●		●				
7	Design and set up a planned maintenance system	B	90	▲	▲	▲	▲	▲	▲		●		●		●		●				
8	Enter the job market	B	60	▲	▲	▲	▲	▲	▲		●		●		●		●				
NUMBER OF OBJECTIVES		4																		8	
DURATION (IN HOURS)			240																		450

S: Situational objective

B: Behavioural objective

△ Correlation between a step and a specific competency

▲ Correlation to be taught and evaluated

○ Correlation between a general and a specific competency

● Correlation to be taught and evaluated

4. GENERAL OBJECTIVES

The general objectives of the *Preventive and Prospective Industrial Maintenance Mechanics* program are presented below, along with the major statement of each corresponding first-level operational objective.

To develop in the students the basic competencies needed to practise the trade.

- Interpret complex plans, specifications, and manuals.
- Apply techniques for measuring vibrations.

To develop in the students the competencies needed to perform tasks of medium complexity (second level of competency).

- Apply concepts of preventive and prospective industrial maintenance.
- Use computer programs for planned maintenance.

To develop in the students the competencies needed to perform more complex tasks.

- Diagnose malfunctions by means of vibration analysis.
- Design and set up a planned maintenance system.

To develop in the students the competencies needed to integrate harmoniously into the job market.

- Determine their suitability for the trade and the training process.
- Enter the job market.

5. FIRST- AND SECOND-LEVEL OPERATIONAL OBJECTIVES

5.1 DEFINITION

A first-level objective is defined for each competency to be developed. Competencies are organized into an integrated training program designed to prepare students to practise the trade or occupation. This systematic organization of competencies produces better overall results than training by isolated objectives. More specifically, it fosters a smooth progression from one objective to the next, saves teaching time by eliminating needless repetition, and integrates and reinforces learning material.

First-level operational objectives are the main, compulsory teaching/learning targets and they are specifically evaluated for certification. There are two kinds of operational objectives: behavioural and situational.

- **A behavioural objective** is a relatively closed objective that describes the actions and results expected of the student by the end of a learning step. Evaluation is based on expected results.

- **A situational objective** is a relatively open-ended objective that outlines the major phases of a learning situation. It allows for output and results to vary from one student to another. Evaluation is based on the student's participation in the activities of the learning context.

Second-level operational objectives are intermediate teaching/learning targets deemed prerequisite for attaining first-level objectives. They are grouped according to the specifications (see 5.2 A) or the phases (see 5.2 B) of the first-level objective.

The division of operational objectives into first- and second-level objectives is based on a clear distinction between the levels of learning:

- learning involving prerequisite knowledge
- learning involving competencies

Second-level operational objectives indicate prerequisite knowledge. They prepare the students to learn what is necessary to attain the first-level operational objectives, which collectively lead to the development of a competency. The objectives should always be adapted to meet the particular needs of the individual students or groups of students.

First-level operational objectives cover the learning that the students need to develop a competency:

- The specifications or the phases of the objective determine or guide specific learning, thereby allowing the competency to be developed step by step.

- The objective as a whole (i.e. the six components and in particular the last phase of a situational objective) determines or guides the overall learning and the integration and synthesis of this learning, allowing the competency to be developed fully.

To attain the objectives, the following learning activities may be prepared:

- specific learning activities for second-level objectives
- specific learning activities for the specifications or phases of first-level objectives
- general learning activities for first-level objectives

5.2 HOW TO READ FIRST-LEVEL OPERATIONAL OBJECTIVES

A. How to Read a Behavioural Objective

Behavioural objectives consist of six components. The first three provide an overview of the objective:

1. The **expected behaviour** states a competency in terms of the general behaviour that the students are expected to have acquired by the end of the module.

2. The **conditions for performance evaluation** define what is necessary or permissible to the students during evaluation designed to verify whether or not the students have attained the objective. This means that the conditions for evaluation are the same wherever and whenever the program is taught.

3. The **general performance criteria** define the requirements by which to judge whether or not the results obtained are generally satisfactory.

The last three components ensure that the objective is understood clearly and unequivocally:

4. The **specifications of the expected behaviour** describe the essential elements of the competency in terms of specific behaviours.

5. The **specific performance criteria** define the requirements for each of the specifications of behaviour. They ensure a more enlightened decision on the attainment of the objective.

6. The **field of application** defines the limits of the objective, where necessary. It indicates cases where the objective applies to more than one task, occupation or field.

B. How to Read a Situational Objective

Situational objectives consist of six components:

1. The **expected outcome** states a competency as an aim to be pursued throughout the course.

2. The **specifications** outline the essential aspects of the competency and ensure a better understanding of the expected outcome.

3. The **learning context** provides an outline of the learning situation designed to help the students develop the required competencies. It is normally divided into three phases of learning:

   - information
   - performance, practice or involvement
   - synthesis, integration, and self-evaluation

4. The **instructional guidelines** provide suggested ways and means of teaching the course to ensure that learning takes place and that the same conditions apply wherever and whenever the course is taught. These guidelines may include general principles or specific procedures.

5. The **participation criteria** describe the requirements the students must fulfil, which are usually related to each phase of the learning context. They focus on how the students take part in the activities rather than on the results obtained. Participation criteria are normally provided for each phase of the learning context.

6. **The field of application** defines the limits of the objective, where necessary. It indicates cases where the objective applies to more than one task, occupation or field.

PART II

MODULE 1: THE TRADE AND THE TRAINING PROCESS

SIMCA: BED-288
SESAME: 867-011

Duration: 15 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

EXPECTED OUTCOME

By participating in the required activities of the learning context according to the indicated criteria, the students will be able to
determine their suitability for the trade and the training process.

SPECIFICATIONS

At the end of this module, the students will:

- Be familiar with the nature of the trade.
- Understand the training process.
- Confirm their career choice.

LEARNING CONTEXT

PHASE 1: **Information on the Trade**

- Learning about the job market in preventive and prospective industrial maintenance mechanics--potential work environments, types of establishments, products, job prospects, wages, opportunities for promotion or transfer, selection of candidates--through field trips, interviews, written material, and so on.

- Learning about the nature and the requirements of the job--tasks, working conditions, evaluation criteria, rights and responsibilities of workers--through field trips, interviews, written material, and so on.

- Presenting the information gathered at a group meeting and discussing their views on the trade: advantages, disadvantages, requirements, and so on.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

LEARNING CONTEXT

PHASE 2: **Information on and Participation in the Training Process**

- Discussing the skills, aptitudes, and knowledge required to practise the trade.
- Learning about the training plan: program of study, training process, evaluation methods, certification of studies, and so on.
- Discussing how the training program relates to the work of preventive and prospective industrial maintenance mechanics.
- Discussing their initial reactions to the trade and the training process.

PHASE 3: **Evaluation and Confirmation of Career Choice**

- Producing a report in which they must:
  - describe their preferences, aptitudes, and interests with respect to the trade
  - assess their career choice by comparing the different aspects and requirements of the trade with their own preferences, aptitudes, and interests

INSTRUCTIONAL GUIDELINES

The teacher should:

- Create a climate that is conducive to personal growth and to the students' integration into the job market.
- Encourage all the students to engage in discussions and to express themselves.
- Motivate the students to take part in the suggested activities.
- Help the students to acquire an accurate perception of the trade.
- Provide the students with the means to assess their career choice honestly and objectively.
- Organize field trips to companies that are representative of the main work environments in the trade.
- Make available all pertinent documentation: information on the trade, the training program, guides, and so on.
- Organize a meeting with specialists in the trade.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

PARTICIPATION CRITERIA

PHASE 1:

- Gather information on most of the topics to be dealt with.
- Express their views on the trade in a group meeting, relating them to the information they have gathered.

PHASE 2:

- Give their opinions on some of the requirements that they will have to meet in order to practise the trade.
- Examine carefully the literature provided.
- Listen carefully to explanations.
- Express themselves clearly on the training plan in a group meeting.
- Express their reactions clearly.

PHASE 3:

- Write a report that:
  - sums up their preferences, interests, and aptitudes
  - explains how they arrived at their career choice, relating it to their preferences, interests, and aptitudes

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before undertaking the activities in each of the phases:

1. Be receptive to information about the trade and the training process.
2. Be willing to share their views on the trade with other members of the group.

Before undertaking the activities of Phase 1 (Information on the Trade):

3. Be able to find the appropriate information.
4. Determine how to record and present information.
5. Give the meaning of "entry-level qualifications."
6. Explain the main rules governing group discussions.

Before undertaking the activities of Phase 2 (Information on and Participation in the Training Process):

7. Differentiate among the skills, aptitudes, attitudes, and knowledge required to practise a trade.
8. Describe the nature, purpose, and content of a program of study.

Before undertaking the activities of Phase 3 (Evaluation and Confirmation of Career Choice):

9. Differentiate among preferences, aptitudes, and interests.
10. Describe the main components of a report confirming their career choice.

MODULE 2: INTERPRETING COMPLEX PLANS, SPECIFICATIONS AND MANUALS

SIMCA: BED-289
SESAME: 867-022

Duration: 30 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
interpret complex plans, specifications, and manuals
in accordance with the following conditions, criteria, and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Referring to manufacturers' manuals and maintenance manuals in English and French
- Applying CSA and ISO standards
- Following plans for complex industrial equipment, including general drawings, unit assembly drawings, detail drawings, and the list of materials
- Following plans for an automated system, including symbols for welding, metal structure, hydraulics, electronics, piping, machining, pneumatics, and electricity
- Using a calculator
- Referring to catalogues

GENERAL PERFORMANCE CRITERIA

- Accuracy of information
- Conformity to CSA and ISO standards
- Logical interpretations

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Interpret general, unit assembly, detail, and installation drawings, specifications, and manuals: • for industrial equipment • for operational automated production units	- Accurate interpretations of: • the location of components • the operation of the equipment • the type of installation • specific operations
B. Establish from complex plans: • assembly and dismantling sequences • the operation of a cycle • fabrication and assembly techniques	- Understanding of the logic of assembly - Accurate interpretation of the cycle of operations - Accurate interpretation of functional and position dimensions
C. Locate on plans defective elements related to a malfunction in industrial equipment or an operational automated production unit.	- Accurate interpretation of plans - Accurate location of the malfunction

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret general, unit assembly, detail, and installation drawings, specifications, and manuals: for industrial equipment, for operational automated production units (A):

1. Interpret plans in third-angle projection and first-angle projection, including:
   - double auxiliary views
   - sectional views
   - isometric projections
   - functional dimensioning
2. Identify on plans:
   - materials
   - symbols for machining, hydraulics, pneumatics, welding, electricity, electronics, metal structure, and so on
3. Locate on plans:
   - elements and parts of machines
   - dimensions
   - allowances and tolerances
   - components such as:
     - alignment gauges
     - sensors
     - acceleration meters
     - optical sensors

Before learning how to establish from complex plans: assembly and dismantling sequences, the operation of a cycle, fabrication and assembly techniques (B):

4. Describe the operation of a system based on a project containing:
   - general drawings
   - unit assembly drawings
   - detail drawings
   - the list of materials
   - the maintenance, installation, and operation manual

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to locate on plans defective elements related to a malfunction in industrial equipment or an operational automated production unit (C):

5. Look for information in:
   - specifications
   - the maintenance manual
   - the history of the equipment
   - reference books

MODULE 3: APPLYING TECHNIQUES FOR MEASURING VIBRATIONS

SIMCA: BEE-281
SESAME: 867-034

Duration: 60 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
apply techniques for measuring vibrations
in accordance with the following conditions, criteria, and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Following specific instructions
- Referring to the manufacturer's specifications
- Referring to the history of a piece of equipment
- Using reference manuals
- Working on industrial and production equipment
- Using measuring instruments such as a vibration analyser, a vibrometer, and a stroboscope
- Using the appropriate protective equipment

GENERAL PERFORMANCE CRITERIA

- Observance of health and safety rules
- Appropriate use of measuring instruments
- Accuracy of readings and data gathered
- Conformity to established procedures
- Understanding of the consequences of vibrations on the operation of equipment

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Associate vibration with a defective element.	- Accurate understanding of the phenomenon of vibration and its parameters - Accurate explanation of the sources of vibration
B. Place vibration analysis in the context of preventive and prospective maintenance.	- Accurate association of vibration analysis with preventive and prospective maintenance
C. Apply occupational health and safety rules.	- Systematic application of individual and group safety measures
D. Measure the vibration levels of equipment using vibrometers and vibration analysers.	- Use of appropriate techniques - Choice of appropriate parameter
E. Compare the data gathered with established standards and procedures.	- Appropriate use of charts, tables, SI 2372 standards, and trend studies - Accurate comparison of spectra
F. Recognize the defective elements of a piece of equipment.	- Accurate analysis and interpretation of data gathered - Accurate comparison of detection spectra (PBC)
G. Write reports.	- Accurate summary - Use of correct technical terms - Correct English
H. Clean and tidy the work area.	- Proper storage of tools and equipment

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to associate vibration with a defective element (A):

1. List the elements that can become defective.
2. List the operating conditions that may generate a vibration.

Before learning how to measure the vibration levels of equipment using vibrometers and vibration analysers (D):

3. Be familiar with various types of vibration pickups and their principal characteristics.
4. Understand the operation of vibrometers and vibration analysers.

Before learning how to recognize the defective elements of a piece of equipment (F):

5. Be familiar with various charts, tables, and standards related to vibrations.

MODULE 4: APPLYING CONCEPTS OF PREVENTIVE AND PROSPECTIVE INDUSTRIAL MAINTENANCE

SIMCA: BEE-282
SESAME: 867-043

Duration: 45 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **apply concepts of preventive and prospective industrial maintenance** in accordance with the following conditions, criteria, and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Referring to plans and specifications
- Following work orders
- Referring to the history of a piece of equipment
- Referring to maintenance schedules
- Using reference manuals
- Referring to an oil analysis
- Using operational industrial equipment
- Using measuring and monitoring instruments such as:
  - the appropriate indicators
  - a sonometer
- Using the accessories required for oil sampling

GENERAL PERFORMANCE CRITERIA

- Observance of health and safety rules
- Accuracy of technical data gathered
- Understanding of the various methods of maintenance
- Proper procedures and techniques
- Clean, careful work

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Describe the importance of corrective, preventive, and prospective maintenance in the contemporary industrial context.	- Accurate demonstration of the optimization of productivity with respect to aspects such as: • decreased maintenance costs • reduction of inventories • quality of the finished product • greater safety
B. Explain the following concepts: • corrective maintenance • preventive or systematic maintenance • prospective or conditional maintenance	- Accurate distinctions among the various types of maintenance - Accurate description of the advantages and limitations of each type of maintenance
C. Identify various methods of observation applicable to preventive and prospective maintenance, such as: • vibration measurement • oil analysis • thermography • examination of surfaces • structural examination • productivity control • acoustic measurement	- Establishment of correlations between methods and types of maintenance
D. Associate instruments, tools, and accessories with the various methods.	- Accurate associations with maintenance methods
E. Interpret plans, specifications, and maintenance manuals.	- Accurate interpretation of plans and data
F. Apply health and safety rules.	- Systematic observance of individual and group safety measures

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
G. Carry out various technical procedures: • in preventive maintenance: • visual examination • mandatory periodical verification • adjustment • in prospective maintenance: • noise measurement • reading oil analysis reports	- Proper procedure and observance of standards - Appropriate choice of parameters to measure - Appropriate use of tools, instruments, and accessories
H. Collect data and establish maintenance sheets.	- Accuracy of data - Quality of data analysis - Appropriate recommendations
I. Clean and tidy the work area.	- Appropriate storage of tools and equipment

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to describe the importance of corrective, preventive, and prospective maintenance in the contemporary industrial context (A):

1. Recognize the elements and components that require particular attention.
2. List the technical features of these elements.

Before learning how to identify various methods of observation applicable to preventive and prospective maintenance, such as: vibration measurement, oil analysis, thermography, examination of surfaces, structural examination, productivity control, acoustic measurement (C):

3. Be familiar with the basic concepts of acoustics.

Before learning how to interpret plans, specifications, and maintenance manuals (E):

4. Identify the symbols related to equipment maintenance.

MODULE 5: USING COMPUTER PROGRAMS FOR PLANNED MAINTENANCE

SIMCA: BEE-283
SESAME: 867-055

Duration: 75 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
use computer programs for planned maintenance
in accordance with the following conditions, criteria, and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Referring to plans and specifications
- Following work orders
- Referring to management reports
- Referring to maintenance schedules
- Referring to the history of a piece of equipment
- Using operational industrial equipment
- Using computer programs for planned maintenance
- Using a microcomputer and printer

GENERAL PERFORMANCE CRITERIA

- Observance of health and safety standards
- Accuracy of calculations
- Appropriate use of software and equipment
- Accuracy of technical data gathered
- Concern for the reduction of repair costs
- Concern for maintenance management
- Clean, careful work

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Use a computer.	- Appropriate use of computer
B. Explain the flowchart of a computer program.	- Correct explanation
C. Use computer programs for corrective, preventive, and prospective maintenance.	- Appropriate choice of computer program for the type of maintenance - Proper use of the various directories in the programs - Accurate data entry
D. Apply techniques of preventive and prospective maintenance.	- Appropriate application of maintenance techniques - Appropriate use of computer programs
E. Make recommendations.	- Appropriate recommendations on the basis of data gathered
F. Tidy the work area.	- Proper cleaning and storage of tools, equipment, and computer programs - Cleanliness of work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to explain the flowchart of a computer program (B):

1. Be familiar with the structure of directories.

Before learning how to use computer programs for corrective, preventive, and prospective maintenance (C):

2. Be familiar with the commands and functions of the programs to be used.
3. Be familiar with the design programs used in maintenance.

Before learning how to make recommendations (E):

4. Be familiar with the tasks involved in the various trades.
5. Be familiar with the causes of malfunctions.

MODULE 6: DIAGNOSING MALFUNCTIONS BY MEANS OF VIBRATION ANALYSIS

SIMCA: BEE-284
SESAME: 867-065

Duration: 75 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
diagnose malfunctions by means of vibration analysis
in accordance with the following conditions, criteria, and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Referring to plans and specifications
- Following work orders
- Referring to maintenance reports
- Referring to maintenance schedules
- Using reference manuals
- Referring to a maintenance history
- Using vibrational spectra
- Using operational industrial and production equipment
- Using measuring and monitoring equipment such as a vibration analyser, a stroboscope, a tunable filter, an envelope detector, and a frequency multiplier
- Using database programs, a microcomputer, and a printer

GENERAL PERFORMANCE CRITERIA

- Observance of health and safety rules
- Accuracy of calculations
- Appropriate use of instruments and equipment
- Appropriate use of the various methods of vibration analysis
- Expected result: accurate diagnosis of malfunctions by means of vibration analysis

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Interpret plans, specifications, and operating and maintenance manuals for equipment.	- Accurate interpretation of plans and information
B. Establish the history of the piece of equipment.	- Accurate understanding of history and appropriateness of information gathered
C. Plan the work.	- Logical sequence of operations
D. Apply occupational health and safety rules.	- Systematic observance of individual and group safety measures
E. Use measuring instruments such as: • a vibration analyser • an envelope detector • a frequency multiplier • a tunable filter	- Use of instruments in accordance with instruction manuals
F. Diagnose malfunctions by means of vibration analysis, using methods such as: • phase angle measurement • envelope analysis • analysis of the inverse transform of the power spectrum logarithm • analysis of the transient signal	- Understanding and mastery of the various methods of vibration analysis - Appropriate choice of method of vibration analysis according to the malfunction
G. Take corrective measures in accordance with the diagnosis.	- Appropriate verification of the parameters of operation - Appropriate choice of corrective measures - Conformity to specifications
H. Carry out tests.	- Proper testing procedure and conformity to operating conditions

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
I. Write reports.	- Quality of reporting and relevance of information - Correct English - Accurate use of technical terms
J. Clean and tidy the work area.	- Appropriate storage of tools and equipment

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to establish the history of the piece of equipment (B):

1. Question the persons responsible.
2. Interpret the maintenance sheets for the equipment.
3. Be familiar with the circumstances at the source of the change of amplitude of the vibrations of the equipment.

Before learning how to use measuring instruments such as: a vibration analyser, an envelope detector, a frequency multiplier, a tunable filter (E):

4. Be familiar with the technical specifications of the instruments.
5. Calibrate the instruments.

Before learning how to diagnose malfunctions by means of vibration analysis, using methods such as: phase angle measurement, envelope analysis, analysis of the inverse transform of the power spectrum logarithm, analysis of the transient signal (F):

6. Explain diagnostic principles.
7. Identify frequencies generated by defective bearings.

MODULE 7: DESIGNING AND SETTING UP A PLANNED MAINTENANCE SYSTEM

SIMCA: BEE-285
SESAME: 867-076

Duration: 90 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
design and set up a planned maintenance system
in accordance with the following conditions, criteria, and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Referring to plans and specifications
- Following work orders
- Using reference manuals
- Referring to the history of the parts and equipment
- Referring to management reports
- Using operational machines and industrial equipment
- Using computer programs for preventive and corrective (planned) maintenance
- Using measuring equipment and accessories such as a vibrometer, a sonometer, a vibration analyser, a stroboscope, an accelerometer, a gauge, and a sensor
- Using a microcomputer and printer

GENERAL PERFORMANCE CRITERIA

- Observance of health and safety rules
- Accuracy of technical data gathered
- Appropriate use of instruments, software, and equipment
- Concern for maintenance management
- Concern for the reduction of operating costs

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
A. Codify equipment.	- Identification of a codification standard - Appropriate codification
B. Put together the information on the industrial equipment targeted, using sources such as: • plans and specifications • the history of the equipment • technical data from the manufacturer	- Accurate summary of the principal characteristics of the equipment
C. Determine the type of monitoring of equipment required for corrective, preventive, and prospective maintenance.	- Proper choice of important components for production - Appropriate choice of type of monitoring - Correct association of monitoring required with the type of maintenance decided on - Conformity to manufacturers' standards
D. Choose the parameters to monitor.	- Accurate choice of parameters - Accuracy of measurements and readings - Accurate and complete data entry
E. Determine the monitoring thresholds and establish the frequency of attention and sequence of actions.	- Conformity to established procedures - Conformity to the requirements of the equipment
F. Apply health and safety rules.	- Systematic observance of individual and group safety measures

FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR	SPECIFIC PERFORMANCE CRITERIA
G. Enter relevant information in the computer programs for planned maintenance.	- Appropriate use of computer program - Appropriate choice of information
H. Install accessories at the points where measurements are to be taken.	- Proper installation
I. Carry out readings of the initial state of the equipment.	- Accurate readings - Accurate comparison
J. Interpret data and diagnose the source of divergences from the established thresholds.	- Accurate interpretation - Understanding of the operation of the equipment - Appropriate diagnosis
K. Take corrective measures in accordance with the diagnosis.	- Appropriate choice of corrective measures - Proper repair and maintenance methods
L. Carry out tests.	- Proper testing procedures - Results above established thresholds
M. Save and update data.	- Appropriate use of computer programs - Accurate data entry
N. Clean and tidy the work area.	- Appropriate storage of tools, instruments, and accessories - Cleanliness of work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to put together the information on the industrial equipment targeted, using sources such as: plans and specifications, the history of the equipment, technical data from the manufacturer (B):

1. List the data needed for identifying equipment.

Before learning how to determine the type of monitoring of equipment required for corrective, preventive, and prospective maintenance (C):

2. Identify the selection characteristics of the equipment.
3. List the characteristics of the types of maintenance: corrective, preventive, prospective.

MODULE 8: ENTERING THE JOB MARKET

SIMCA: BEE-286
SESAME: 867-084

Duration: 60 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

EXPECTED OUTCOME

By participating in the required activities of the learning context according to the indicated criteria, the students will be able to
enter the job market.

SPECIFICATIONS

At the end of this module, the students will:

- Be familiar with the work environment.
- Have adjusted their perceptions regarding: the work context; occupational practices; their aptitudes, preferences, and interests; the training received; and so on.
- Be prepared to function in the work environment.

LEARNING CONTEXT

PHASE 1: **Preparation for the Practicum**

- Receiving information on the practicum and related arrangements.

- Establishing criteria for selecting establishments.

- Listing establishments likely to accept students for a practicum.

- Taking steps to obtain a placement for the practicum.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

LEARNING CONTEXT

PHASE 2: **Observation of and Participation in Activities in the Workplace**

- Observing the work context: the socio-economic environment (products, market), trade associations, the structure of the establishment, the equipment, technological developments, working conditions, interpersonal relations, health and safety, and so on.

- Observing, carrying out, or helping carry out various tasks of the trade.

- Producing a brief report presenting their observations on the work context and the tasks carried out during the practicum (if any).

PHASE 3: **Comparison of Their Initial Perceptions with the Reality of the Workplace**

- Noting aspects of the trade that differ from the training received.

- Discussing the accuracy of their perceptions of the trade before and after the practicum, with respect to the work environment, occupational practices, and so on.

- Discussing the consequences this experience will have on their choice of future employment (aptitudes, preferences, interests).

INSTRUCTIONAL GUIDELINES

The teacher should:

- Provide students with the means to make an appropriate choice of an establishment in which to do their practicum.
- Maintain close cooperation between the school and the establishment.
- Arrange for the students to observe and carry out tasks of the trade.
- Arrange for the constant supervision of the students by a person designated by the establishment.
- Provide regular supervision of the students.
- Take action in case of difficulties.

FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE

INSTRUCTIONAL GUIDELINES

- Encourage all the students to take part in discussions and express their opinions, particularly when they are choosing the enterprise in which they will do their practicum and when they are comparing their initial perceptions with their experience in the workplace.

PARTICIPATION CRITERIA

PHASE 1:

- List in order of priority three establishments that meet the criteria they have set for a practicum placement.
- Meet with a representative of the establishment with a view to being accepted for a practicum placement.

PHASE 2:

- Observe the policies of the establishment with respect to work schedules, activities they are permitted to carry out as students, and so on.
- Produce a report containing information on at least five of the areas to be observed and descriptions of the tasks carried out or observed.

PHASE 3:

- Discuss with their colleagues their experience in the workplace on the basis of the report they have written.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before undertaking the activities of Phase 1 (Preparation for the Practicum):

1. Describe the steps in planning a search for a practicum placement.
2. List the attitudes needed for a creative search for a practicum placement.

Before undertaking the activities of Phase 2 (Observation of and Participation in Activities in the Workplace):

3. Describe the information to be noted during the practicum.
4. Describe the behaviour to be adopted in the work environment.

Before undertaking the activities of Phase 3 (Comparison of Their Initial Perceptions with the Reality of the Workplace):

5. List their aptitudes, preferences, and interests with respect to the trade.
6. Describe the requirements of the work environment.

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